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BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Application Number: 10/776,222
Filing Date: February 12, 2004
Appellant(s): GIRT ET AL.

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GROUP 1700

Bernard P. Codd
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed July 9, 2007 appealing from the Office action mailed December 8, 2006.

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The statement of the status of claims contained in the brief is correct.

(4) Status of Amendments After Final

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is ***substantially*** correct. The Examiner notes that the first paragraph of the summary clearly summarizes the sole independent claim, claim 1, as required by 37 CFR 41.37(c)(1)(v). The additional paragraphs are directed to the subject matter in the dependent claims.

(6) Grounds of Rejection to be Reviewed on Appeal

The appellant's statement of the grounds of rejection to be reviewed on appeal is correct. ***The Examiner notes that the teaching references Chen et al. (U.S. Patent No. 6,759,149 B1) and Girt et al. (U.S. Patent No. 6,777,112 B1) relied upon in the Final Office Action mailed December 8, 2006 were withdrawn in the Advisory Action mailed March 26, 2007 (see last Paragraph).***

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

(8) Evidence Relied Upon

WO 99/24973	LAMBETH ET AL.	05-1999
2004/0027868 A1	NAKAMURA ET AL.	02-2004
2003/0186086 A1	ABARRA ET AL.	10-2003
2004/0191578 A1	CHEN ET AL.	09-2004
5,922,442	LAL ET AL.	07-1999
2004/0043258 A1	YAMAMOTO ET AL.	03-2004

Malhotra, S., Stafford, D., Lal, B., Russak, M., "Effect of CrRu Underlayer on the Magnetic, Recording, and Thermal Stability Characteristics of CoCrPtTa Thin Film Media", IEEE Trans. Mag., vol. 36, no. 5 (Sept 2000), pp. 2309 - 2311.

(9) Grounds of Rejection

Examiner's Comment from Paragraph No. 1 of the Office Action mailed June 23, 2006: Regarding the limitation(s) "adhesion layer" in claims 18 and 19, the Examiner has given the term(s) the broadest reasonable interpretation(s) consistent with the written description in applicants' specification as it would be interpreted by one of ordinary skill in the art. In re Morris, 127 F.3d 1048, 1054-55, 44 USPQ2d 1023, 1027 (Fed. Cir. 1997); In re Donaldson Co., Inc., 16 F.3d 1190, 1192-95, 29 USPQ2d 1845, 1848-50 (Fed. Cir. 1994). See MPEP 2111. Specifically, the Examiner notes that "adhesion layer" is simply nomenclature and is not defined in the record. As such, any layer formed between the substrate and the soft magnetic layer would meet the limitation of "adhesion layer" for claims 18 and 19 (for claim 19, only provided it meets the further compositional limitations of the claim).

The following ground(s) of rejection are applicable to the appealed claims:

Claims 1, 13, 14, 17, 18 and 20 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Lambeth et al. (WO 99/24973) in view of Nakamura et al. (U.S. Patent App. No. 2004/0027868 A1).

Regarding claim 1, Lambeth et al. disclose a perpendicular magnetic recording medium (*page 42, last paragraph*), comprising a non-magnetic substrate (*Table II and page 51, lines 9 – 11: HF-Si(111)*) having a surface, and a layer stack formed over said substrate surface, said layer stack comprising, in overlying sequence from said

substrate surface: a magnetically soft underlayer (*page 51, lines 9 – 11: "NiFe(111)"*); a non-magnetic interlayer structure (*"Ag(111)/Ti(0002)"*); and a magnetically hard perpendicular main recording layer(*"CoCrPtTa(0002)"*); wherein said non-magnetic interlayer structure is a structure comprising a layer of *fcc* Au-containing non-magnetic material having a <111> preferred growth orientation (*page 16, lines 7 – 20: where Au and Ag are both taught as suitable fcc materials*) and a layer of a different material in overlying or underlying contact with said layer of *fcc* Au-containing non-magnetic material (*"Ti(0002)"*).

Lambeth et al. fail to disclose the layer of different material comprising Ru, instead teaching a layer of hcp Titanium (*"Ti(0002)"*).

However, the Examiner deems that hcp titanium layers and hcp Ru layers or Ru alloy layers are known functional equivalents in hcp non-magnetic interlayers for use in controlling the crystallographic growth, orientation and properties of perpendicular recording media, as taught by Nakamura et al. (*Paragraphs 0011, 0042 and 0055*).

Substitution of functional equivalents requires no express motivation as long as the prior art recognizes the functional equivalency. In the instant case, Ti and Ti alloys and Ru and Ru alloys are functional equivalents in the field of hcp non-magnetic interlayers for use in controlling the crystallographic growth, orientation and properties of perpendicular recording media. *In re Fount* 213 USPQ 532 (CCPA 1982); *In re Siebentritt* 152 USPQ 618 (CCPA 1967); *Graver Tank & Mfg. Co. Inc. v. Linde Air Products Co.* 85 USPQ 328 (USSC 1950).

Regarding claims 13 and 14, Lambeth et al. disclose recording layers meeting appellants' claimed limitations (*page 22, line 31 bridging page 23, line 10 and Table II*).

Regarding claims 17, 18 and 20, Lambeth et al. disclose substrates, "adhesion layers", and protective layers/lubricants meeting appellants' claimed limitations (*page 22, lines 24 – 30 and page 23, lines 11 – 35*).

Claims 1 – 5 and 11 – 20 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Abarra et al. (U.S. Patent App. No. 2003/0186086 A1) in view of the knowledge in the art, as exemplified by Chen et al. (U.S. Patent App. No. 2004/0191578 A1) <u>and/or</u> Lal et al. (U.S. Patent No. 5,922,442) <u>and/or</u> Malhotra et al. (IEEE Trans. Mag., 36(5), 9/2000, 2309 – 2311).

Regarding claim 1, Abarra et al. disclose a perpendicular magnetic recording medium (*Paragraph 0016*), comprising: a non-magnetic substrate (*Figure 13, element 51 and relevant disclosure thereto*) having a surface, and a layer stack formed over said substrate surface, said layer stack comprising, in overlying sequence from said substrate surface: a magnetically soft underlayer (*element 61*); a non-magnetic interlayer structure (elements 62/53/54/55); and a magnetically hard perpendicular main recording layer(element 56 and relevant disclosure thereto); wherein said non-magnetic interlayer structure is a structure comprising a layer of *fcc* Au-containing non-magnetic material having a <111> preferred growth orientation (*Paragraphs 0070 – 0073 and 0077*) and a layer of a different material in overlying or underlying contact with said layer of *fcc* Au-containing non-magnetic material (*element 54*).

While the Examiner deems that Abarra et al. disclose the Au or Au-X material with sufficient specificity, the Examiner acknowledges that Abarra et al. fail to explicitly disclose selecting Au or Au-X from the list of *fcc* materials.

However, Abarra et al. teach that alloying the Al_3Ti element with Au (among other equivalent materials) "provide a more uniform lattice for the magnetic layer **56** to grow on or for the adhesive layer **54** to grow on" (*Paragraph 0077*).

It would therefore have been obvious to one of ordinary skill in the art at the time of the appellants' invention to modify the device of Abarra et al. to utilize a material meeting applicants' claimed compositional limitations as taught by Abarra et al., since such a choice can "provide a more uniform lattice for the magnetic layer **56** to grow on or for the adhesive layer **54** to grow on" and substitution of functional equivalents requires no express motivation as long as the prior art recognizes the functional equivalency. In the instant case, Au and Cu, Ag, Pt, Pd, etc. are functional equivalents in the field of elements capable of being alloyed with Al_3Ti and still result in a *fcc* <111> crystal orientation. *In re Fount* 213 USPQ 532 (CCPA 1982); *In re Siebentritt* 152 USPQ 618 (CCPA 1967); *Graver Tank & Mfg. Co. Inc. v. Linde Air Products Co.* 85 USPQ 328 (USSC 1950).

Abarra et al. further fail to disclose the layer of different material comprising Ru, instead teaching that element 54 comprises a *bcc Cr-M alloy*, such as CrMo, CrTi, CrV or CrW.

However, the Examiner deems that *bcc* CrRu layers and *bcc* Cr-M alloy layers are known functional equivalents in *bcc* non-magnetic interlayers for use in controlling

the crystallographic growth, orientation and properties of subsequently deposited *hcp* based Co-alloy intermediate or recording media, as taught by Chen et al. ('578 A1) (*Paragraphs 0032 – 0033*), Lal et al. (*col. 3, line 65 bridging col. 4, line 14*), and Malhotra et al. (*entire disclosure*).

Substitution of functional equivalents requires no express motivation as long as the prior art recognizes the functional equivalency. In the instant case, CrRu and Cr-M alloys are functional equivalents in the field of *bcc* non-magnetic interlayers for use in controlling the crystallographic growth, orientation and properties of subsequently deposited *hcp* based Co-alloy intermediate or recording media.

Regarding claims 2 and 3, Abarra et al. disclose thickness ranges meeting appellants' claimed limitations (*Paragraphs 0078 – 0080 and 0093*).

Regarding claims 4 and 5, Abarra et al. disclose materials and thickness values meeting appellants' claimed limitations (*Paragraphs 0077 and 0078*).

Regarding claims 11 and 12, Abarra et al. disclose soft magnetic layers meeting appellants' claimed limitations (*Paragraphs 0012 and 0089*).

Regarding claims 13 and 14, Abarra et al. disclose magnetic layers meeting appellants' claimed limitations (*Paragraph 0081*).

Regarding claims 15 and 16, Abarra et al. disclose using an amorphous layer meeting appellants' claimed material, thickness and intended use limitations (*Paragraphs 0089 – 0090*).

Regarding claims 17 – 19, Abarra et al. disclose substrates and "adhesion layers" meeting appellants' claimed material limitations (*Paragraphs 0071, 0087 and 0088*).

Regarding claim 20, Abarra et al. disclose overcoats and lubricant layers meeting appellants' structural limitations (*Figure 13, elements 57 and 58, and relevant disclosure thereto*).

Claims 1 – 5 and 11 – 20 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Abarra et al. ('086 A1) in view of Yamamoto et al. (U.S. Patent App. No. 2004/0043258 A1) and the knowledge in the art, as exemplified by Chen et al. ('578 A1) <u>and/or</u> Lal et al. ('442) <u>and/or</u> Malhotra et al. (IEEE Trans. Mag., 36(5), 9/2000, 2309 – 2311).

Regarding claim 1, Abarra et al. disclose a perpendicular magnetic recording medium (*Paragraph 0016*), comprising: a non-magnetic substrate (*Figure 13, element 51 and relevant disclosure thereto*) having a surface, and a layer stack formed over said substrate surface, said layer stack comprising, in overlying sequence from said substrate surface: a magnetically soft underlayer (*element 61*); a non-magnetic interlayer structure (elements 62/53/54/55); and a magnetically hard perpendicular main recording layer(element 56 and relevant disclosure thereto); wherein said non-magnetic interlayer structure is a structure comprising a layer of *fcc* Au-containing non-magnetic material having a <111> preferred growth orientation (*Paragraphs 0070 – 0073 and*

0077) and a layer of a different material in overlying or underlying contact with said layer of *fcc* Au-containing non-magnetic material (*element 54*).

While the Examiner deems that Abarra et al. disclose the Au or Au-X material with sufficient specificity, the Examiner acknowledges that Abarra et al. fail to explicitly disclose selecting Au or Au-X from the list of *fcc* materials.

However, Yamamoto et al. teach that selection of an alloy of Au with elements meeting appellants' claimed limitations can be selected for both lattice size matching and chemical stability (*Paragraphs 0019 – 0021*). While Yamamoto et al. only illustrate the situation with a Cu-X alloy, Yamamoto et al. teach the equivalents of Cu to Au as suitable *fcc* based materials (*Paragraph 0019*).

It would therefore have been obvious to one of ordinary skill in the art at the time of the appellants' invention to modify the device of Abarra et al. to utilize a material meeting appellants' claimed compositional limitations as taught by Yamamoto et al., since such a choice can result in improved lattice matching and improved chemical stability and substitution of functional equivalents requires no express motivation as long as the prior art recognizes the functional equivalency. In the instant case, Au and Al, Cu, Rh, Pd, Ag and Ir are functional equivalents in the field of elements capable of being alloyed with additional elements and still result in a *fcc* <111> crystal orientation.

Neither Abarra et al. nor Yamamoto et al. disclose the layer of different material comprising Ru, instead teaching that element 54 comprises a *bcc Cr-M alloy*, such as CrMo, CrTi, CrV or CrW.

However, the Examiner deems that *bcc* CrRu layers and *bcc* Cr-M alloy layers are known functional equivalents in *bcc* non-magnetic interlayers for use in controlling the crystallographic growth, orientation and properties of subsequently deposited *hcp* based Co-alloy intermediate or recording media, as taught by Chen et al. ('578 A1) (*Paragraphs 0032 – 0033*), Lal et al. (*col. 3, line 65 bridging col. 4, line 14*), and Malhotra et al. (*entire disclosure*).

Substitution of functional equivalents requires no express motivation as long as the prior art recognizes the functional equivalency. In the instant case, CrRu and Cr-M alloys are functional equivalents in the field of *bcc* non-magnetic interlayers for use in controlling the crystallographic growth, orientation and properties of subsequently deposited *hcp* based Co-alloy intermediate or recording media.

Regarding claims 2 and 3, Abarra et al. disclose thickness ranges meeting appellants' claimed limitations (*Paragraphs 0078 – 0080 and 0093*).

Regarding claims 4 and 5, Abarra et al. disclose materials and thickness values meeting appellants' claimed limitations (*Paragraphs 0077 and 0078*).

Regarding claims 11 and 12, Abarra et al. disclose soft magnetic layers meeting appellants' claimed limitations (*Paragraphs 0012 and 0089*).

Regarding claims 13 and 14, Abarra et al. disclose magnetic layers meeting appellants' claimed limitations (*Paragraph 0081*).

Regarding claims 15 and 16, Abarra et al. disclose using an amorphous layer meeting appellants' claimed material, thickness and intended use limitations (*Paragraphs 0089 – 0090*).

Regarding claims 17 – 19, Abarra et al. disclose substrates and "adhesion layers" meeting appellants' claimed material limitations (*Paragraphs 0071, 0087 and 0088*).

Regarding claim 20, Abarra et al. disclose overcoats and lubricant layers meeting appellants' structural limitations (*Figure 13, elements 57 and 58, and relevant disclosure thereto*).

Claims 1 – 5, 11 – 13, 17 and 20 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Yamamoto et al. ('258 A1) in view of Nakamura et al. ('868 A1).

Regarding claim 1, Yamamoto et al. disclose a perpendicular magnetic recording medium (*Paragraph 0001*), comprising: a non-magnetic substrate (*Figure 1, element 10 and relevant disclosure thereto*) having a surface, and a layer stack formed over said substrate surface, said layer stack comprising, in overlying sequence from said substrate surface: a magnetically soft underlayer (*element 11*); a non-magnetic interlayer structure (elements 12 and 13); and a magnetically hard perpendicular main recording layer(element 14 and relevant disclosure thereto); wherein said non-magnetic interlayer structure is a structure comprising a layer of *fcc* Au-containing non-magnetic material having a <111> preferred growth orientation (*Paragraphs 0014 and 0015*) and a layer of a different material in overlying or underlying contact with said layer of *fcc* Au-containing non-magnetic material (*element 13*).

Yamamoto et al. fail to disclose the layer of different material comprising Ru, instead teaching a layer of *hcp* CoCr.

However, Nakamura et al. teach that instead of using a layer of *hcp* CoCr between the *fcc* layer and the magnetic layer, that one should use a layer of *hcp* Ru inorder to improve the lattice matching between the seed layer and the magnetic layer, and hence improve the perpendicular magnetic properties (*Paragraphs 0032 – 0034 and examples*).

It would, therefore, have been obvious to one of ordinary skill in the art at the time of the applicant's invention to modify the device of Yamamoto et al. to utilize a layer comprising Ru meeting appellants' claimed limitations as taught by Nakamura et al., since such a layer can improve the lattice matching between the seed layer and the magnetic layer, and hence improve the perpendicular magnetic properties.

Regarding claims 2 and 3, Yamamoto et al. disclose thickness ranges meeting appellants' claimed limitations (*Paragraph 0026*).

Regarding claims 4 and 5, Yamamoto et al. disclose materials and thickness values meeting appellants' claimed limitations (*Paragraphs 0014 – 0021 and examples – where the Examiner notes that while Yamamoto et al. explicitly disclose Cu-X alloys, they also teach that Cu and Au are both suitable fcc materials to use for the layer*).

Regarding claims 11 and 12, Yamamoto et al. disclose soft magnetic layers meeting appellants' claimed limitations (*Paragraphs 0040*).

Regarding claim 13, Yamamoto et al. disclose magnetic layers meeting appellants' claimed limitations (*Paragraph 0040*).

Regarding claims 17 and 20, Yamamoto et al. disclose substrates, overcoats and lubricant layers meeting appellants' structural limitations (*Paragraph 0040*).

Claims 14 – 16, 18 and 19 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Yamamoto et al. ('258 A1) in view of Nakamura et al. ('868 A1) as applied above, and further in view of Abarra et al. ('086 A1).

Regarding claims 14 – 16, 18 and 19, Yamamoto et al. and Nakamura et al. are relied upon as described above.

Regarding claims 14 – 16, 18 and 19, Yamamoto et al. fail to disclose the specifics of the claimed recording media.

However, Abarra et al. teach that the magnetic layer thickness (claim 14) can be varied to affect the magnetic properties in a perpendicular recording medium (*Paragraph 0081*). Therefore, the Examiner deems that it would have been obvious to one having ordinary skill in the art to utilize a thickness value meeting appellants' claimed limitations by optimizing the results effective variable through routine experimentation. *In re Boesch*, 205 USPQ 215 (CCPA 1980); *In re Geisler*, 116 F. 3d 1465, 43 USPQ2d 1362, 1365 (Fed. Cir. 1997); *In re Aller*, 220 F.2d, 454, 456, 105 USPQ 233, 235 (CCPA 1955).

Regarding claims 15 and 16, Abarra et al. teach providing an amorphous layer meeting appellants' claimed limitations between the soft magnetic layer and the non-magnetic interlayer structure inorder to promote small grain sizes in the interlayer structure (*Paragraphs 0089 – 0090*).

Regarding claims 18 and 19, Abarra et al. teach providing an "adhesion layer" meeting appellants' claimed limitations to improve the adhesion of layers to the substrate surface (*Paragraphs 0087 – 0088*).

(10) Response to Argument

Argument 1: the rejections predicated on Lambeth et al. (WO '973)

Appellants argue that the "Examiner has not established that hcp titanium and hcp Ru or Ru alloy layers are known equivalents in perpendicular magnetic recording media having a non-magnetic interlayer structure, wherein the interlayer structure comprises a layer of *fcc* Au-containing non-magnetic material having a <111> preferred growth orientation and a layer comprising Ru in overlying or underlying contact with the layer of *fcc* Au-containing non-magnetic material, as required by the elected species of claim 1" (*page 6 of Appeal*). Specifically arguing that the prior art "does not disclose TI, but rather an alloy of Ti and 10 at% Cr" (*ibid*) and that "[o]ne of skill in this art would not consider Ru and Ti to be equivalents for use in a nonmagnetic layer" (*page7 of Appeal*), pointing to the differences in magnetic properties, lattice constants and surface energies (*pages 6 – 7 of Appeal*). The Examiner respectfully disagrees.

First, the Examiner notes that a prior art reference teaching a Ru or Ru alloy layer in an exactly identical interlayer structure would be anticipatory art under 35 U.S.C. 102. Since an invention may be unpatentable if it is *either anticipated or obvious*, the Examiner deems that a *prima facie* case of obviousness does not require an explicit teaching of the exactly identical structure as claimed in a single reference.

An invention may be unpatentable provided the prior art demonstrates sufficient specificity to render the claimed invention obvious to one of ordinary skill at the time of Appellants' invention.

In the instant case, Lambeth et al. teach the general structure claimed, including the use of a non-magnetic *fcc* material (*which can be Au*) and a non-magnetic *hcp* material (*Ti*). The Examiner deems that the cited prior art clearly illustrates that non-magnetic *hcp* Ti or Ti alloy deposited over a non-magnetic *fcc* Au layer would be a functional equivalent structure to a non-magnetic *hcp* Ru or Ru alloy deposited over a non-magnetic *fcc* Au layer (*see Nakamura et al. Paragraphs 0032 and 0034 below*).

[0032] The seed layer 103 and 203 and the nonmagnetic underlayer 104 and 204 are described in the following. The nonmagnetic underlayer is necessarily comprised of a metal or an alloy with a hexagonal closest packed (hcp) crystal structure. Preferable material includes a metal selected from Re, Ru, and Os, or an alloy mainly comprised of one or more elements selected from Re, Ru, and Os for controlling alignment of the granular magnetic layer. The degree of mismatching between the a-axis lattice constant of the nonmagnetic underlayer and the a-axis lattice constant of the magnetic layer is preferably not larger than 10%. The seed layer is preferably comprised of a metal or an alloy with the face centered cubic (fcc) lattice structure. Specifically, the seed layer is preferably comprised of a metal selected from Cu, Au, Pd, Pt, and Ir, an alloy mainly comprised of one or more metals selected from Cu, Au, Pd, Pt, and Ir, or an alloy mainly comprised of Ni and Fe.

[0034] When the material for the seed layer is selected from a metal including Cu, Au, Pd, Pt, and Ir, an alloy mainly comprised of one or more metals selected from Cu, Au, Pd, Pt, and Ir, and an alloy mainly comprised of Ni and Fe, and at the same time, the material for the nonmagnetic underlayer is selected from a metal including Ti, Re, Ru, and Os, and an alloy mainly comprised of one or more metals selected from Ti, Re, Ru, and Os, then the lattice matching between the seed layer and the nonmagnetic underlayer and the lattice matching between the nonmagnetic underlayer and the granular magnetic layer are more favorable. Thus, superior perpendicular magnetic recording medium can be obtained.

Next, Appellants argue that the Examiner has failed to discharge his burden by failing to provide the requisite motivation to combine the references (*pages 7 – 10 of Appeal Brief*). The Examiner respectfully disagrees, noting that the courts have recognized that a substitution of known functional equivalents is within the knowledge of one of ordinary skill in the art, especially where the prior art explicitly recognizes the functional equivalency. Furthermore, the Examiner points to the same examples that Appellants pointed to, inorder to illustrate that the prior art even recognized that Ru

appeared to exhibit a higher coercivity and signal to noise ratio versus a Ti alloy (*see Nakamura et al., Table 1*). Hence, not only is Ru disclosed as a functional equivalent to Ti (*e.g. Nakamura et al., Paragraph 0034 above*), there is guidance in the art to specifically utilize Ru over Ti when seeking to improve the magnetic characteristics of a perpendicular magnetic recording medium.

TABLE 1

underlayer	Hc (Oe)	S	SNR (dB)	$\Delta\theta_{50}$
Ti-10 at. % Cr	2,060	0.78	13.9	10.6
Ti	1,220	0.39	10.2	11.9
Re	4,500	0.89	16.2	5.0
Ru	4,800	0.95	15.7	5.2

Arguments 2 and 3: the rejections predicated on Abarra et al. ('086 A1)

Appellants argue that the "Examiner has not established that bcc CrRu layers and bcc Cr-M alloy layers are known equivalents in perpendicular magnetic recording medium having a non-magnetic interlayer structure, wherein the interlayer structure comprises a layer of *fcc* Au-containing non-magnetic material having a <111> preferred growth orientation and a layer comprising Ru in overlying or underlying contact with the layer of *fcc* Au-containing non-magnetic material, as required by the elected species of claim 1" (*pages 10 - 11 of Appeal*) or that the "Examiner has not established that the Cr-M alloy of Abarra et al. and the CrRu alloy layers of Chen et al., Lal et al., and Malhotra et al. are known equivalents" (*pages 13 - 15 of Appeal*). Specifically arguing that "because different elements and alloys have different lattice parameters and crystallographic structures and the effect the underlayer has on the overall magnetic recording medium is also dependent on the lattice parameters and crystallographic

structure of underlying and overlying layers, it is clear that one of skill in this art would not have recognized that the Cr-M alloy layer of Abarra et al. and the CrRu layers of Chen et al., Lal et al., and Malhotra et al. are known equivalents in the claimed magnetic recording medium (*pages 11 and 15 of Appeal Brief*). The Examiner respectfully disagrees.

It is the Examiner's position that if the prior art recognizes the equivalency in terms of the behavior of the non-magnetic Cr-M alloy for use as an underlayer in a magnetic recording medium, then there is sufficient specificity in the art to render the claimed invention obvious as a mere substitution of known functional equivalents. In the instant case, the Examiner notes that the teachings regarding the Cr alloys possess ***significant*** overlap in the alloys to be added to Cr for the formation of the underlayer structure (*see Abarra et al., Paragraph 0046; Chen et al., Paragraph 0033; Lal et al., col. 3, line 65 bridging col. 4, line 14; and Malhotra et al., Introduction*). As such, the Examiner maintains that one of ordinary skill in the art would have recognized that the Cr-M alloys taught by Abarra et al. and the CrRu alloys known in the art were functional equivalent alloys for use as a non-magnetic grain control underlayer.

Abarra et al. text

[0046] The intermediate layer **5** is made of a Cr—M alloy having a BCC crystal structure with a thickness of 1 to 30 nm, where M is an element selected from a group of B, Mn, Mo, Ti, V and W. Such materials used for the intermediate layer **5** has the proper lattice parameter to promote epitaxy with the magnetic layer **7**. In addition, Cr adheres very well to various kinds of materials such that the Cr—M alloy makes a good buffer layer between the underlayer **4** and the magnetic layer **7**.

Chen et al. text

[0033] In a preferred embodiment of the present invention **30** as shown in **FIG. 2**, an underlayer **36** of chromium alloy (CrA, where A=Ru, Mo, Mn, W, Ti, V, Zr, etc.) is deposited by DC or RF magnetron sputtering onto any of a variety of disk substrates **32**, with a seed layer **34** formed before the underlayer **36**. A magnetic layer **38** is then deposited on the underlayer **36** followed by an overcoating **40** to protect the magnetic layer. Suitable disk substrates include NiP-coated

Lal et al. text

Underlayer 14 is preferably formed of a chromium-based alloy, which, as used herein includes chromium (Cr) and alloys containing greater than about 80% chromium. Exemplary alloys include CrV, CrSi, CrGd and CrRu. In a preferred embodiment, the underlayer is a CrRu alloy containing between about 2–20% ruthenium, more preferably 2–10% ruthenium, and remainder chromium. Alloy percentages reported herein are atomic weight percentages, for example, a 90/10 CrRu alloy refers to an alloy of 90 atomic percent chromium and 10 atomic percent ruthenium.

It will be appreciated that the underlayer, when formed of chromium or of a binary alloy such as CrRu, may also contain minor amounts of other elements. For example, any of the following elements when added in amounts of less than about 5%, preferably less than about 3%, to the CrRu alloy may be suitable for the underlayer of the invention: Si, Cu, Pt, Al, Mo, Ta, Ge, B, Ni, W, V, Hf, No, Zr, Ti, Os, Pd, Sb and C.

Malhotra et al. Introduction text: "The lattice mismatch between the Cr underlayer and Co alloy can be reduced by alloying the Cr underlayer with elements such as V, Mo, Ti, Mn and W [1] – [5]. Here we report for the first time the effect of CrRu underlayer on the magnetic, recording and thermal stability characteristics and their correlation with grain size, magnetic switching volume and crystallographic orientation for CoCrPtTa thin film media"

Finally, Appellants argue that the Examiner has failed to discharge his burden by failing to provide the requisite motivation to combine the references (*pages 11 – 13 and 15 - 17 of Appeal Brief*). The Examiner respectfully disagrees, noting that the courts have recognized that a substitution of known functional equivalents is within the knowledge of one of ordinary skill in the art, especially where the prior art explicitly recognizes the functional equivalency. Furthermore, as above, the Examiner notes that the prior art appears to suggest that CrRu is a preferred Cr-M alloy in view of the magnetic, recording, and thermal stability characteristics of the recording medium.

Arguments 4 and 5: the rejections predicated on Yamamoto et al. ('258 A1)

Appellants argue that "there is no suggestion in Nakamura et al. to use a layer of hcp Ru **instead** of hcp CoCr to improve lattice matching between seed layer and the

magnetic layer and hence improve the perpendicular magnetic properties" (*pages 18 and 21 of Appeal Brief, emphasis in original*). The Examiner respectfully disagrees.

The Examiner notes that the broad recitation in Yamamoto et al. merely requires a *hcp* non-magnetic intermediate layer, and that the CoCr layer is an illustrative material used by Yamamoto et al. as said non-magnetic *hcp* alloy (*see Abstract; Paragraph 0025; and claim 1*).

(57) **ABSTRACT**

A large-capacity magnetic storage apparatus is disclosed, capable of performing ultra-high density magnetic recording of 50 gigabits or more per 1 square inch. In a perpendicular magnetic recording medium having a non-magnetic intermediate layer and a magnetic recording layer sequentially formed, the non-magnetic intermediate layer is composed of a layer having a face-centered cubic structure and containing a non-magnetic elements excluding Pt. Specifically, the intermediate layer mainly contains at least one selected from the group of elements constituted of Al, Cu, Rh, Pd, Ag, Ir and Au, and is composed of a film having a face-centered cubic (f. c. c.) structure. The magnetic recording layer contains at least Co, Cr and Pt, and is composed of a film having a hexagonal close-packed (h. c. p.) structure. More preferably, a non-magnetic h. c. p. intermediate layer is provided between the non-magnetic intermediate layer and the magnetic recording layer.

What is claimed:

1. A perpendicular magnetic recording medium, comprising:

a substrate;

a soft magnetic layer;

a first intermediate layer having a face-centered cubic structure and containing non-magnetic elements excluding Pt;

a second intermediate layer having a hexagonal close-packed structure being provided above the first intermediate layer and contianing non-magnetic elements; and

a magnetic recording layer formed above the second intermediate layer, containing at least Co, Cr and Pt,

wherein the first intermediate layer and the second intermediate layer is 0.3-25 nm thick in total.

taxial growth in an interface thereof. Therefore, by providing a second non-magnetic intermediate layer having the same h. c. p. structure as that of the magnetic recording layer, the crystal orientation of the magnetic recording layer can be enhanced. When a non-magnetic intermediate layer containing Co and Cr is used, since the intermediate layer is non-magnetized maintaining the h. c. p. structure, the added concentration of Cr need be set in the range from 28 at. % to 45 at. %.

The Examiner notes that when viewed in terms of the broad generic recitation (*noting that claim 1 of Yamamoto et al. is completely silent about the second intermediate layer being CoCr*), Yamamoto et al. merely requires a non-magnetic *hcp* intermediate layer deposited above a non-magnetic *fcc* layer. Nakamura et al. discloses a substantially identical structure, wherein the non-magnetic *hcp* layer is

specified as being Re, Ru, and Os (or their alloys) (*Nakamura et al., Paragraph 0032 and Table 1*).

[0032] The seed layer **103** and **203** and the nonmagnetic underlayer **104** and **204** are described in the following. The nonmagnetic underlayer is necessarily comprised of a metal or an alloy with a hexagonal closest packed (hcp) crystal structure. Preferable material includes a metal selected from Re, Ru, and Os, or an alloy mainly comprised of one or more elements selected from Re, Ru, and Os for controlling alignment of the granular magnetic layer. The degree of mismatching between the a-axis lattice constant of the nonmagnetic underlayer and the a-axis lattice constant of the magnetic layer is preferably not larger than 10%. The seed layer is preferably comprised of a metal or an alloy with the face centered cubic (fcc) lattice structure. Specifically, the seed layer is preferably comprised of a metal selected from Cu, Au, Pd, Pt, and Ir, an alloy mainly comprised of one or more metals selected from Cu, Au, Pd, Pt, and Ir, or an alloy mainly comprised of Ni and Fe.

TABLE 1

underlayer	Hc (Oe)	S	SNR (dB)	Δθ50
Ti-10 at. % Cr	2,050	0.78	13.9	10.6
Ti	1,220	0.35	10.2	11.9
Re	4,900	0.89	16.0	5.0
Ru	4,800	0.95	15.7	5.2

As such, the Examiner deems that there is sufficient guidance in the art to suggest that a non-magnetic *hcp* intermediate layer comprising Ru is a functional equivalent to the non-magnetic *hcp* intermediate layer disclosed in Yamamoto et al. and illustrated by a CoCr alloy.

Finally, Appellants argue that the Examiner has failed to discharge his burden by failing to provide the requisite motivation to combine the references (*pages 18 – 20, 22 and 23 of Appeal Brief*). The Examiner respectfully disagrees, noting that the courts have recognized that a substitution of known functional equivalents is within the knowledge of one of ordinary skill in the art, especially where the prior art explicitly recognizes the functional equivalency. Furthermore, as above, the Examiner notes that the prior art appears to suggest that Ru is a preferred non-magnetic *hcp* alloy in view of the coercivity and signal to noise behavior reported by Nakamura et al. (*Table 1, above*).

(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

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